Studies in the Capparaceae XIX: *Cleome torticarpa* n. sp., a Venezuelan Endemic

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ABSTRACT. We describe *Cleome* (sect. *Tarenaya*) *torticarpa* H. H. Iltis & T. Ruiz Zapata n. sp., a distinct, very local endemic annual, known only from wet gallery forests along a perpetually flowing river that exits the mouth of a cave in the Cueva de la Quebrada El Toro National Park, Estado Falcón, Venezuela. It is distinguished from *C. latifolia* Vahl by flattened and then twisted short fruits with more or less explosive dehiscence, and from *C. parviflora* HBK, in addition, by the always 3-foliolate leaves.

RESUMEN. Se describe *Cleome* (sect. *Tarenaya*) *torticarpa* H. H. Iltis & T. Ruiz Zapata n. sp., una especie endémica muy localizada, conocida solamente del Parque Nacional Cueva de la Quebrada El Toro en el Estado Falcón, Venezuela, donde crece en un ambiente permanentemente húmedo. Se distingue de *C. latifolia* Vahl por sus frutos aplanados, torcidos y con una dehiscencia más o menos explosiva, y además de *C. parviflora* HBK, por sus hojas siempre 3-folioladas.

Recent fieldwork in Estado de Falcón, Venezuela (Ruiz Zapata, 1985), brought to light a very local and essentially unarmed *Cleome* of the spiny section *Tarenaya* (Marcgraf ex Rafinesque) Iltis ex Jacobs, a distinctive undescribed species characterized by flattened, twisted siliques, hence to be called:

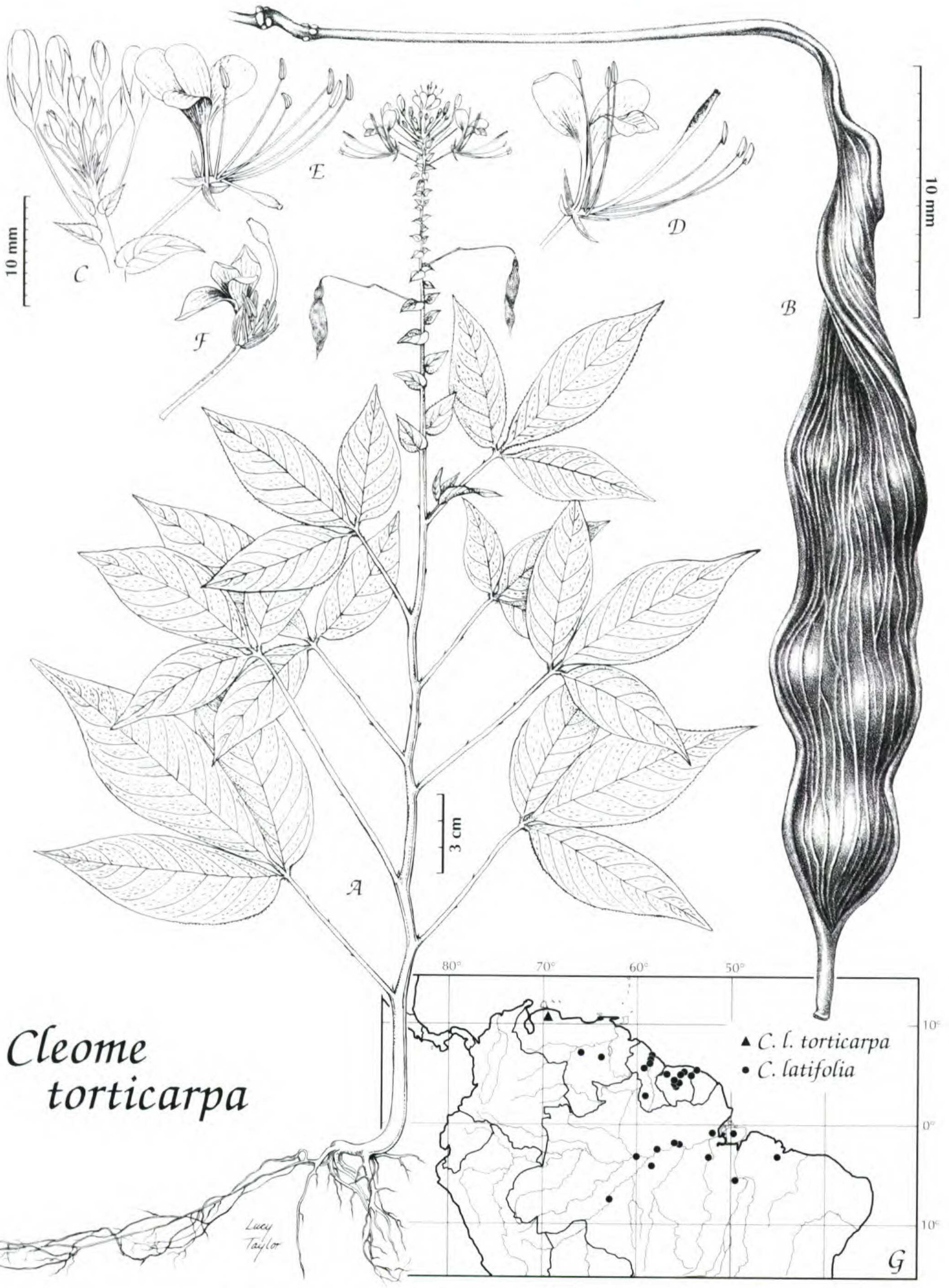
Cleome torticarpa H. H. Iltis & T. Ruiz Zapata, sp. nov. TYPE: Venezuela. Estado Falcón: Distrito Federación, Parque Nacional Cueva de la Quebrada El Toro, 10°50′N, 69°07′W, en selva de galería, bajo sombra, 200 m abajo de la "toma de agua" en la estación del Parque, 600 m, 29 Oct. 1983 (fl y fr), *Thirza Ruiz Zapata & Teo Ruiz 4138* (holotype, MY; isotypes, COL, F, K, MER, MO, NY, US, VEN, WIS). Figures 1, 2.

A *Cleome latifolia* Vahl siliquis planis, sed tortuosis et brevioribus differt, sed foliis 3-foliolatis similis, et a *C. parviflora* HBK siliquis planis, sed tortuosis et foliis semper 3-foliolatis differt.

Slender, unbranched or few-branched, subglabrous, mesophytic, herbaceous *annual*, 15–50 cm tall, with delicate superficial fibrous roots, the erect smooth stems 3–5 mm diam., often basally decumbent-ascending and rooting at the lower nodes, usually lacking "stipular" spines or with a pair of very short (< 1 mm) spines at base of petioles, with many short zig-zag internodes (6–12 per 10 cm), hence (especially near the base) the leaves often crowded.

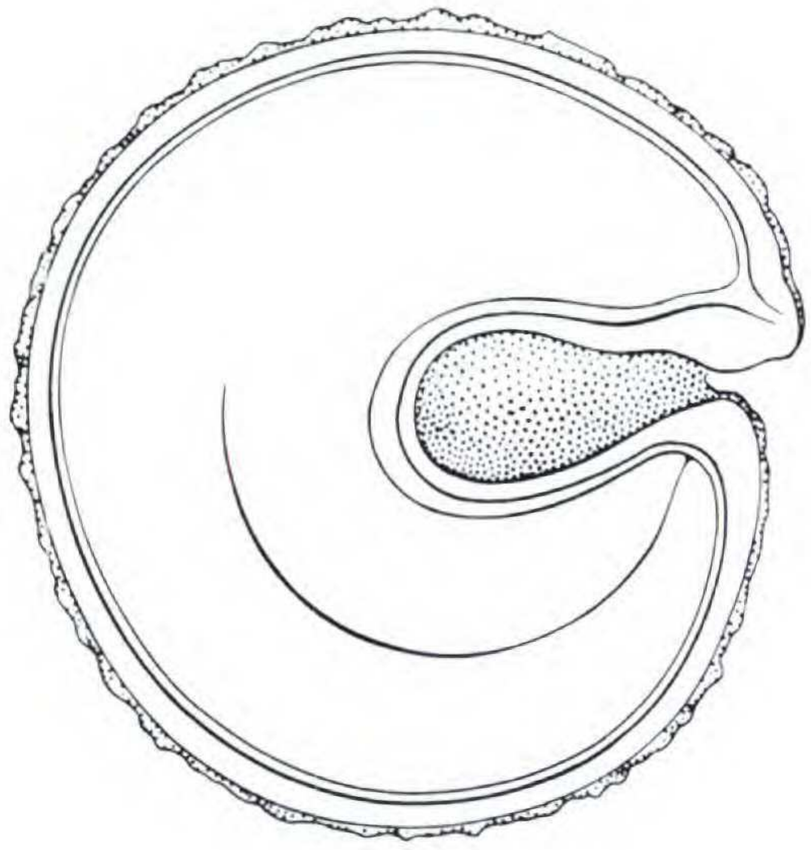
Leaves relatively large, thin, and long-petioled; leaflets 3, the larger 9 × 3 cm to 16 × 5 cm, acuminate to caudate-acuminate at the apex, the central leaflet oblanceolate-elliptic and cuneate at the base, the lateral leaflets lanceolate and strongly asymmetric, with the outer half of the blade broadly rounded or even subcordate at the base, the inner half narrowly attenuate to the petiolule; leaf blades thin, very sparsely pilose with distantly scattered, pustulate, eglandular hairs on both sides, entire, but with short, sharply ascending, eglandular marginal hairs, 10–17 per cm; lateral veins 6–9 on each side, strongly ascending; *petiolules* sometimes quite prominent (4–14 mm long in the central leaflet, shorter in the laterals), these near the base and on the adjoining end of the petiole ± densely minutely puberulent on the upper side; *petioles* of the major leaves 7–12 cm long, rarely [but significantly] with a few scattered, 1–2 mm long, divergent or ascending straight *prickles* on their underside.

Racemes many-flowered, 3–33 cm long, the axis with age often greatly elongating and very slender, ± densely bracteate, the up-to-60 bracts unifoliolate, the lowest ones cordate-ovate to suborbicular and abruptly acuminate, relatively large (8 × 8 to 27 × 19 mm), the upper often greatly reduced in



Cleome torticarpa

Figure 1. *Cleome torticarpa* H. H. Iltis & T. Ruiz Zapata. —A. Whole plant, showing shallow root system (*Flora Falcón 404*). —B. Fruit. —C. Flower buds (B, C, *Ruiz Zapata 4138*). —D. Hermaphrodite (perfect) flower. —E. "Male" flower. —F. "Female" flower (all from cultivated plants, ex Ruiz Zapata 1985, 1990). (A–C, drawing by Lucy Taylor, D, E, by Aristides Mata). —G. Total distribution of *Cleome torticarpa* (triangle) and *C. latifolia* (solid dots).



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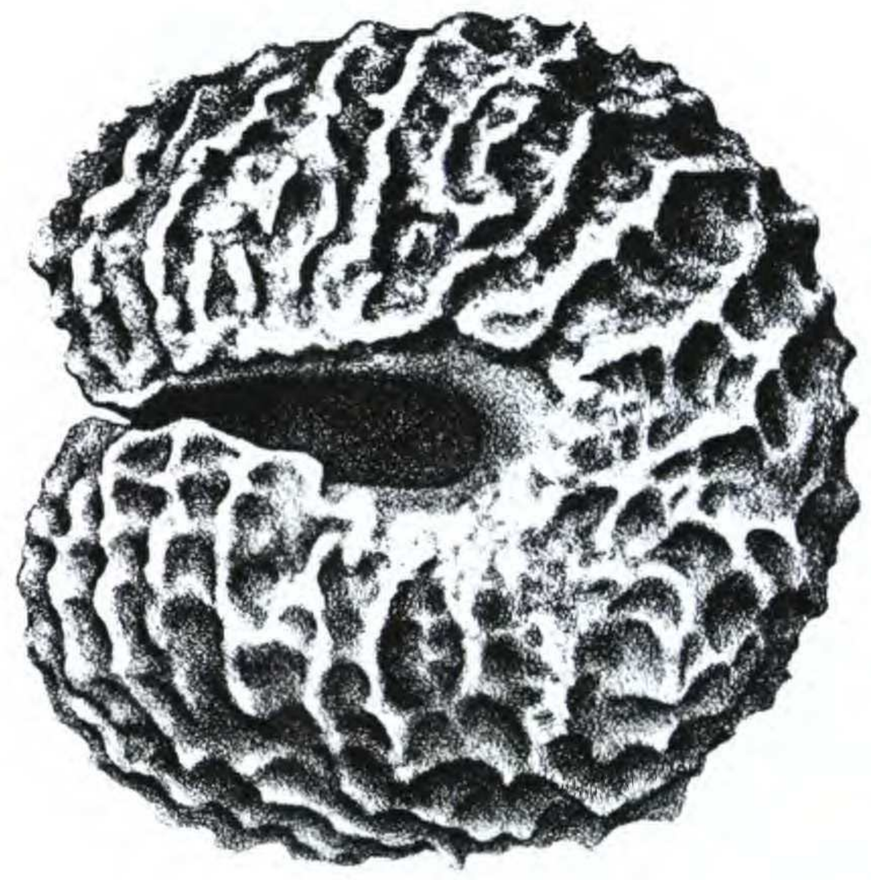

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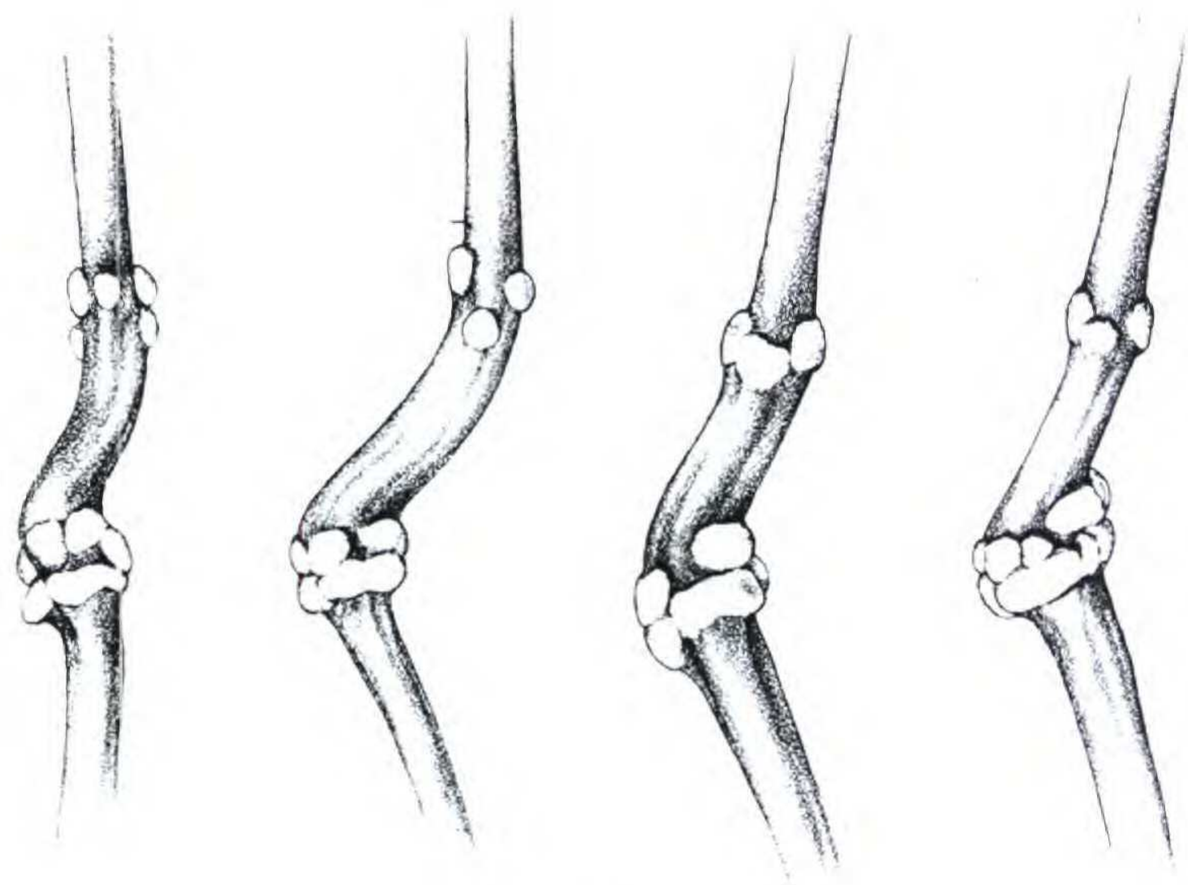

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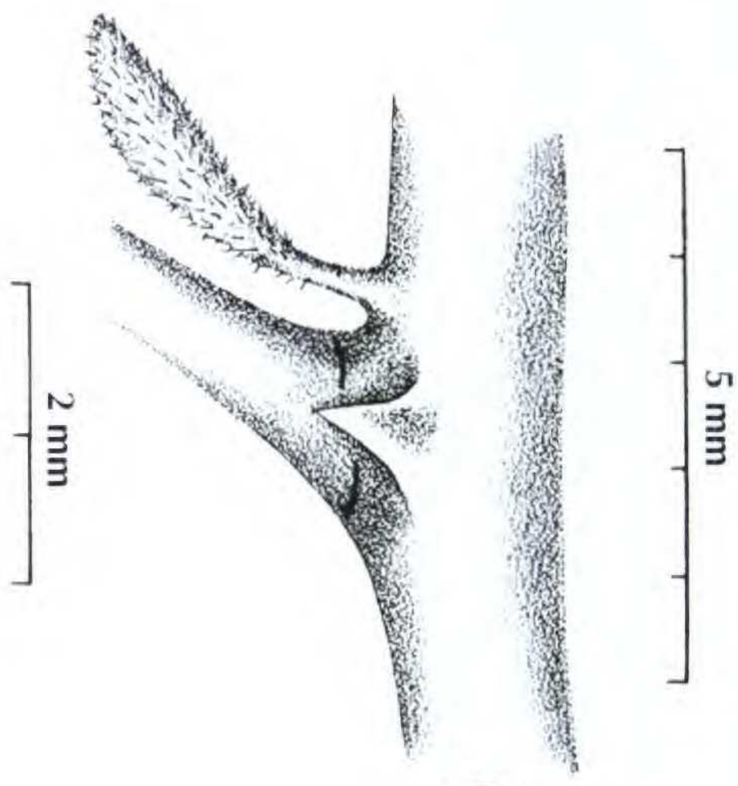

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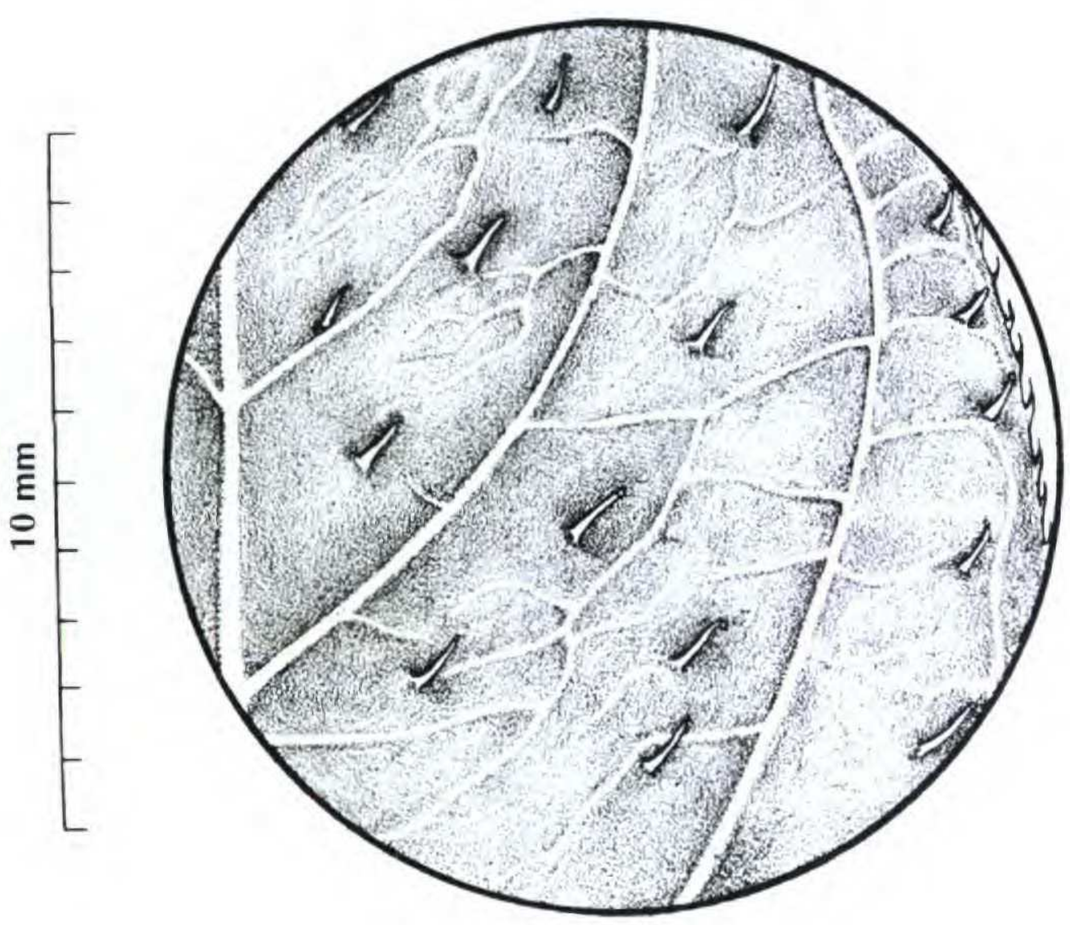

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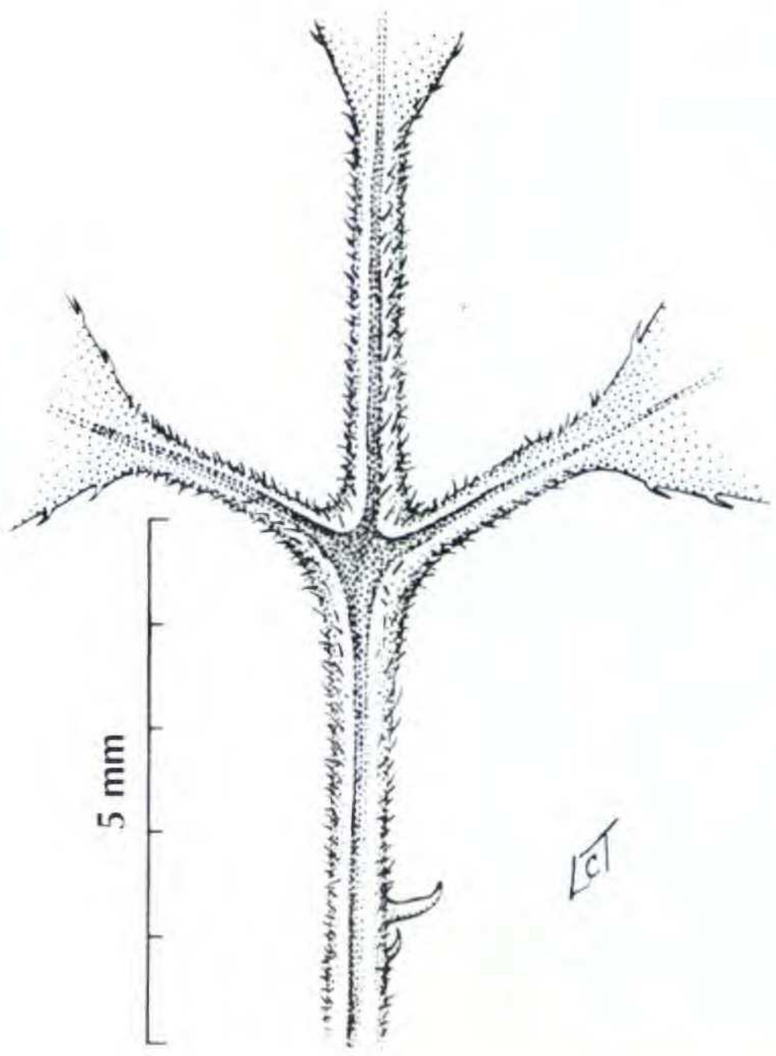

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Figure 2. *Cleome torticarpa*. —A. Seed cross section showing embryo and internal seed cavity. —B. Surface view of seed (*Ruiz Zapata 4138*). —C. Receptacle, from base on up: top of pedicel, sepal scars, petal scars, androgynophore, stamen scar, and base of gynophore [from left to right: *Ruiz Zapata 4138* (2), *Flora Falcón 404*, *Liesner et al. 7791*]. —D. Spine at leaf base (*Ruiz Zapata 4138*). —E. Leaf surface with stiff, short, eglandular hairs. —F. Leaf showing petiolules, and petiole with prickles (E, F, *Ruiz Zapata 4131*).

size, ovate or lanceolate to linear (4 × 2 mm or less), often caducous, with the racemes at times appearing almost ebracteate.

Flowering raceme apices (petal to petal, not including stamens) ca. 4–5 cm diam., with 1–5 open flowers and 8–12 buds at any one time, the latter just preceding anthesis only 8 mm long. *Pedicels* 8–14 mm long. *Flowers* zygomorphic, perfect, or the upper mostly male; *sepals* 4, linear- to lanceolate-caudate, 4–6 × 0.7–1.5 mm, with short white hairs on back and margin, divergent to somewhat reflexed at anthesis; *petals* 4, white (rarely light pinkish because of fading), 12–18 mm long [blades 6–7(–12) × 3–5 mm, the greenish claws 5–8 mm long], the middle pair slightly larger than the lateral, all adaxial and erect, facing outward; *stamens* 6, the upward-arching greenish filaments (15–)18–20(–23) mm long, borne on a distinct, slender, short *androgynophore* ca. 2 mm long (i.e., the filament base fused for 2 mm to the gynophore base; cf. Fig. 2C); receptacle lacking any noticeable nectariferous gland or disc; anthers 3–4 mm, with divergent basal tails, the filaments inserted 1/3 up the anther; *gynophore* filiform, 12–14(–18) mm, carrying an ellipsoid, minutely puberulous, 6–10 × 1 mm ovary with a 1-mm-long style and a subcapitate stigma.

Fruits linear to oblongoid *siliques*, at maturity few on any one raceme (at most 2 or 3, and these often clustered near the raceme base), quite flattened and twisted 1–2 times, 15–27(–36) mm long, 4–6 mm wide, 3 mm thick, subglabrous or glabrous, green, the pale yellowish, longitudinally parallel veins prominent, occasionally anastomosing and sometimes connected by much thinner secondary veinlets; fruit dehiscence ± explosive when, ejecting the seeds, the valves separate suddenly from the replum (placenta), from top down and bottom up, or more commonly either one or both ends remaining permanently attached with the valves bulging outward and especially the lower end of the valves permanently "pinched" into place by the two "arms" of the placenta at the extremely contracted narrow base of the silique; *style* 1 mm long, truncate; *siliques* borne on a slender *pedicel* 10–16 mm long, a distinct *androgynophore* 2–3 mm long, and a slender *gynophore* 14–16(–20) mm long, all ascending together to the extremely narrowly contracted base of the silique which, together with the top of the gynophore, *curves sharply downward* by 90° or more, so that the fruit becomes strongly deflexed at maturity.

Seeds 3–14 per silique, subspherical-reniform, 2.1–2.7 mm long, 2.1–2.9 mm wide, 2.0–2.1 mm thick, exarillate, rusty-brown, verrucose and transversely striatulate (ridged) on back and sides, the cleft membrane narrow, smooth, very thin, flush with the testa except for a slight invagination between the tips of the seed claws, the internal cleft cavity ovoid, small. Testal stomata (under SEM) present (Ruiz Zapata & Escala, 1995). [Recent research with Scanning Electron Microscopy has shown that most cleomoid taxa have scattered stomates on the seed testa (Vanderpool, 1989). According to Ruiz Zapata and Escala (1995), these stomates are present in most of the native *Cleome* species of Venezuela (*C. aculeata* L., *C. anomala* HBK, *C. arborea* HBK, *C.* guianensis Aublet, *C. hassleriana* Chodat, *C. latifolia* Vahl, *C. moritziana* Eichler, *C. parviflora* HBK, *C. pilosa* Bentham, *C. serrata* Jacquin, *C. speciosa* Rafinesque, *C. spinosa* L., *C. torticarpa* Iltis & Ruiz Zapata, *C. viridiflora* Schreber, as well as the introduced African *C. rutidosperma* DC). The only native species apparently lacking testal stomates are *C. stenophylla* Klotzsch ex Urban and *C. stylosa* Eichler, as well as the other two Old World introductions, *C. viscosa* L. and *C. gynandra* L. (Iltis, 1960).]

A slender herbaceous forest-floor mesophyte of the evergreen riparian or gallery forest (selva siempre verde), *Cleome torticarpa* is known only from the "*Cueva de la Quebrada El Toro*" National Park, 10°50′N, 69°07′W, ca. 7 km from the village of La Taza, at ca. 600 m. Here it is locally abundant for perhaps one or two kilometers in the perpetually moist leaf litter along the damp, shaded margins of a small river that, flowing initially underground, emerges from the mouth of the cave (cueva) at the head of the "quebrada." The nearby calcareous rocky slopes are covered with tropical seasonally dry, deciduous forests (bosques mesofilos deciduos, periódicamente húmedos; Hueck, 1960), a vegetation type characteristic of this region. But even though the river is small, only 3 or 4 m wide and 0.5 m deep, it runs all year round, even in the dry season, with the gallery forest floor habitat of this species permanently moist. It is for this reason, apparently, that *C. torticarpa* flowers and fruits intermittently throughout the year.

Cleome torticarpa is distinct and in some ways unique within *Tarenaya*, a section of *Cleome* with about 30 species known for the great similarity of some of its taxa and the usual presence of straight to curved, paired, pseudo-"stipular" spines on the stems and scattered similar ones on petioles and leaves. All, except the African *Cleome afrospina* Iltis (Iltis, 1967) and a questionably native Hawaiian variety of *C. spinosa* Jacquin, are New World species. The main characters distinguishing *C. torticarpa* are its flattened, twisted, few-seeded, short

siliques, which are deflexed by a sharp downward curvature, usually not of the gynophore apex alone but the narrow silique base as well. Noteworthy also is the relatively distinct androgynophore (i.e., the adhesion or fusion of staminal filaments to the base of the gynophore), a character that has repeatedly evolved in the Cleomoideae, both in the Old World (Iltis, 1960) and in the New (Woodson, 1948; Cochrane, 1977, 1978; Iltis & Cochrane, 1989).

Its trifoliolate leaves with long petioles and the greatly elongated, extremely slender racemes with many small, more or less cordate bracts suggest a relationship to *Cleome latifolia* Vahl of the Guyanas and adjoining Amazonian Brazil (Fig. 1G) as well as to the widespread *C. parviflora* HBK (Ruiz Zapata & Iltis, 1998). In fact, *C. latifolia* also is often nearly unarmed and its spines are only rarely prominent. In *C. torticarpa*, spines are extremely rare, only a few specimens of one collection (*Ruiz Zapata & Ruiz 4131*) having minute (0.6 mm long) varnished "stipular" spines (Fig. 2E) and a few ascending thin prickles on the lower side of the petiole. Nevertheless, this fact, and its general overall similarity to the other species cited above, place *C. torticarpa* squarely in section *Tarenaya*.

While vegetatively resembling *Cleome latifolia*, *C. torticarpa* has fruits that are unique in being flattened and "twisted" and certainly in the more or less explosive dehiscence of their siliques, which, though somewhat less explosively than those of *Impatiens*, may disperse the seeds for up to 50 cm (pers. obs. of the second author on cultivated plants at Maracay), a peculiarity unique in Cleomoideae and evidently related to this torsion. *Cleome latifolia* is a somewhat larger, more robust plant, minutely short-puberulent throughout, the fruits included, and has a receptacle adaxially expanded into a nectariferous fleshy bulge, while its slender fruits, cylindrical, not flattened, and usually much longer (6–10 cm), exhibit normal dehiscence, with the valves releasing the seeds by simply falling off. In Venezuela, *Cleome latifolia* has been rarely collected and then only in Estado Bolívar [margen izquierdo del río Cuchivero, Dto. Cedeño, 120 m s.m., *Fernández 1699* (MY, WIS photocopy), *Ruiz Zapata & Ruiz 4695* (MY); Reserva Forestal "La Paragua," márgenes del río Asa, *Blanco 785* (MO, VEN, WIS photocopy)]. There is also a questionable collection from Estado Guárico that needs verification.

Very similar also in its slender, much elongating, bracteate racemes is the variable *Cleome parviflora*, widespread from Mexico to Argentina, but in Venezuela local in moist or wet habitats and absent from regions with a sharply seasonally dry climate. Its fruits vary from slender and elongate to short and thick (a *C. parviflora* variant differentiated by some as C. *micrantha* Desvaux), and, unlike *C. torticarpa*, are cylindrical-torulose, unevenly constricted, and not pronouncedly nerved. Its plants are generally much more robust, much-branched, and often quite spiny, and, most importantly, almost always have at least some leaves that are 5- or, rarely, 7-foliolate, unlike the uniform 3-foliolate leaves of both *C. torticarpa* and *C. latifolia*.

In conclusion, one may speculate on the evolutionary history of *C. torticarpa*, not only its relationships, but also its peculiar and unique explosive dehiscence, and its extreme localization, more so than that of any other of the ca. 80 New World taxa of *Cleome*. Considering its habitat, perhaps it simply evolved from a minute, highly inbred "founder" population that, adapted like most of its more heliophilic relatives in section *Tarenaya* to continuous moisture, is here restricted to a gallery forest along an ever-flowing stream: in short, to a minute climatological "oceanic island" of shaded humidity surrounded by an "ocean" of seasonally dry forest and woodland aridity. It will be the task of future population biologists to find answers to this question.

But this may soon become difficult, for *Cleome torticarpa* is a severely threatened species. On the one hand, along the river within the National Park there is a swimming area much used by people, which results in brush clearing by the administration and trampling by a public eager to take advantage of a clear, spring-fed pool in this hot and arid tropical climate; and from here all Cleomes have disappeared. On the other hand, though the parts of the National Park are fenced, the herds of free-ranging cattle from neighboring haciendas are equally attracted to the lush vegetation near this stream, and even, on occasion, are able to invade the park itself. It may be that *C. torticarpa* is widespread beyond the park's boundaries, on private hacienda lands, but here, too, expanding agricultural pressures from a rapidly growing human population are expected to increase at least in the near future. Finally, we can perhaps console ourselves with the thought that this insignificant, delicate, shade-loving annual with its uniquely explosive fruits would hardly be missed by anyone were it to go extinct. By all accounts, it seems to be, after all, an evolutionary failure. But its extinction would nevertheless represent the loss of one more small piece of that great puzzle of organic evolution, a loss for which each of us, biologist or not, might well feel a sense of mourning.

Paratypes. VENEZUELA. **Falcón**: Distrito Federación, La Taza, selva siempre verde (seasonal evergreen forest), lado del río, Parque Nacional Cueva de la Quebrada "El Toro," 600 m, 23 Feb. 1979 (fl, fr), *Flora Falcón* [*van der Werff & Simonis*] *404* (CORO, MO, WIS); entre rocas, sobre suelo mojado a la orilla del río permanente (más o menos en el lecho, probablemente inundada a veces), ± expuesta al sol, 600 m, 28 Feb. 1979 (fl, fr), *Wingfield 5879* (CORO); mostly evergreen forest, steep, wet valley along river, 600 m, 10°50′N, 69°07′W, 21 June 1979 (fl, fr), *Liesner, González & Wingfield 7766* (MO, VEN); trail going to La Piedra, slope above river, 600–900 m, 22 June 1979 (fl, fr), *Liesner, González & Wingfield 7791* (MO, VEN, WIS); trail to water tank and trail along pipe down to valley pumping station, secondary vegetation with remnants of primary forest slope, 600–900 m, 23 June 1979 (fl, fr), *Liesner, González & Wingfield 7913* (MO, VEN, WIS); 3 m del margen derecho de la Quebrada, más abajo de la estación del Parque, en selva de galería, bajo sombra, 20 Nov. 1982 (fl, fr), *Ruiz Zapata, Parra & Mariño 4057* (MY, NY, US, WIS); en selva de galería, bajo sombra en abundante hojarasca (leaflitter), 21 Aug. 1983 (fl, fr), *Ruiz Zapata & Ruiz 4131* (GH, MER, MO, MY, NY, S, UC, US, VEN, WIS).

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